

Modification of high- p_T hadro-chemistry in Au+Au collisions relative to p+p

- Motivation...
- The STAR Experiment...
- Results...
- Summary...

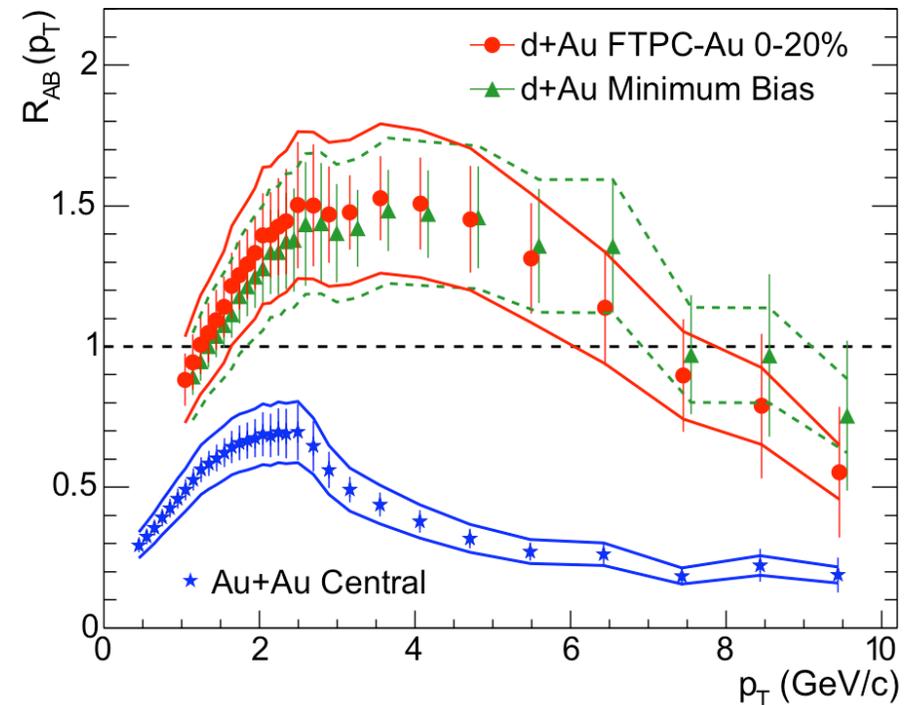


Motivation

Nuclear modification factor...

$$R_{AA}(p_T) = \frac{Yield_{A+A} / \langle N_{bin} \rangle}{Yield_{p+p}}$$

- **Rare processes expected to scale with $\langle N_{bin} \rangle$**
 - $R_{AA} = 1$ if heavy-ion collisions superposition of p+p
- **Deviations from 1 indicate new physics**
 - $R_{AA} > 1$ in d+Au 200 GeV
 - $R_{AA} \sim 0.2$ high p_T h^\pm in Au+Au 200 GeV..

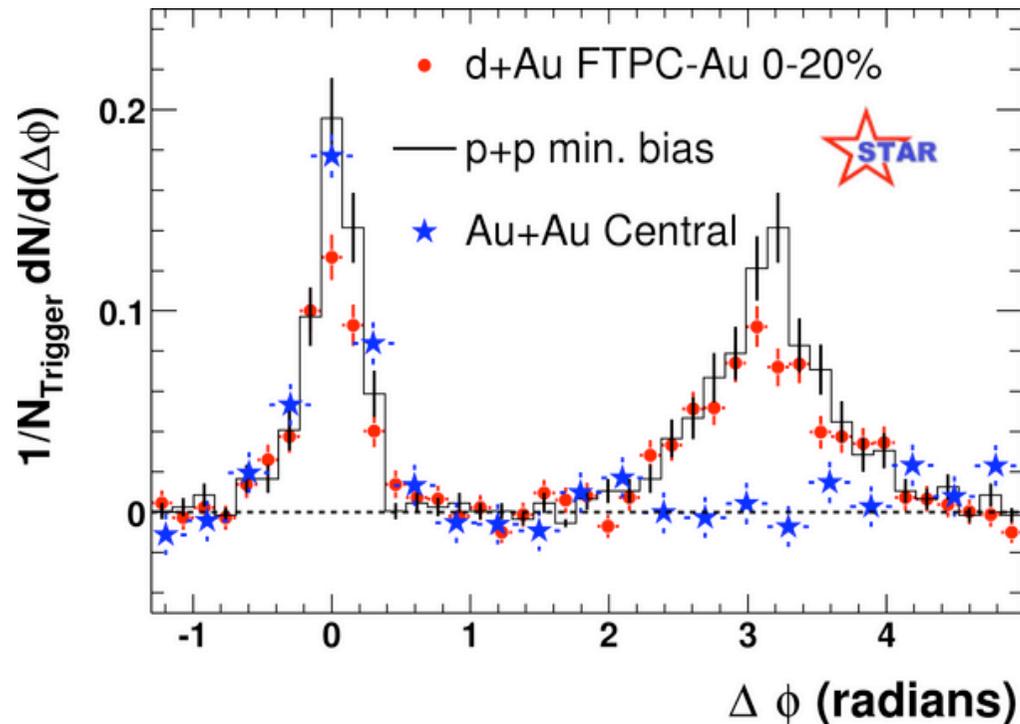


(STAR Collaboration) Nucl. Phys. A 757 (2005) 102



Motivation

2 particle correlations...



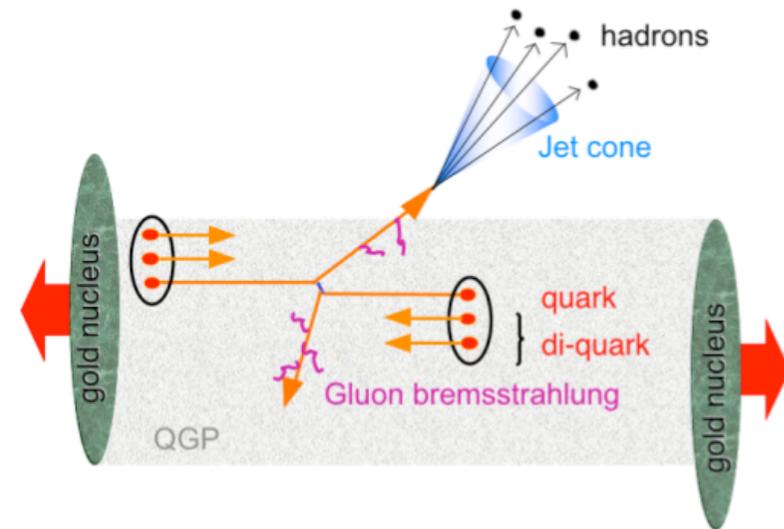
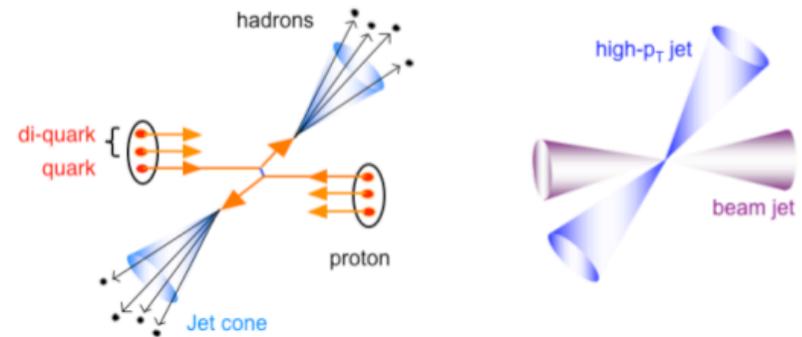
(STAR Collaboration) Nucl. Phys. A 757 (2005) 102

- 2 particle h^\pm correlations reveal angular nature of suppression...
 - **Trigger $p_T > 4$ GeV/c,**
Associated $p_T > 2$ GeV/c
- p+p and d+Au 200 GeV show near and **away side** correlations...
 - Expected from (di) jet production
- Away side **absent** in Au+Au 200 GeV...
 - Di-jet suppression



Motivation

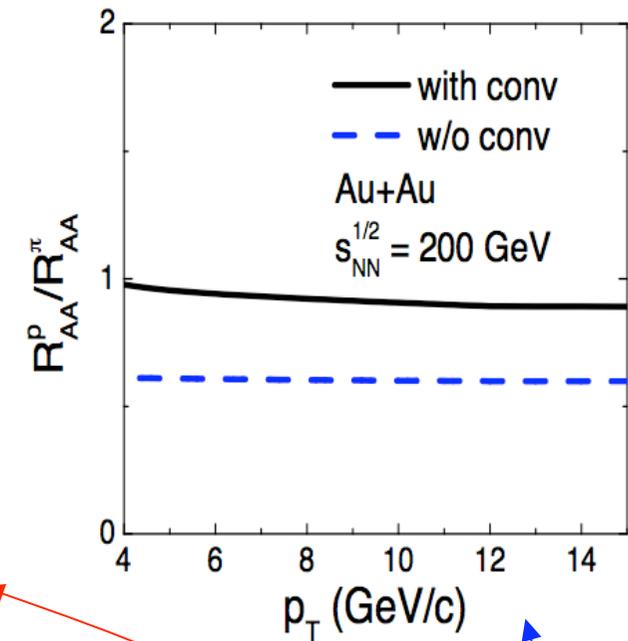
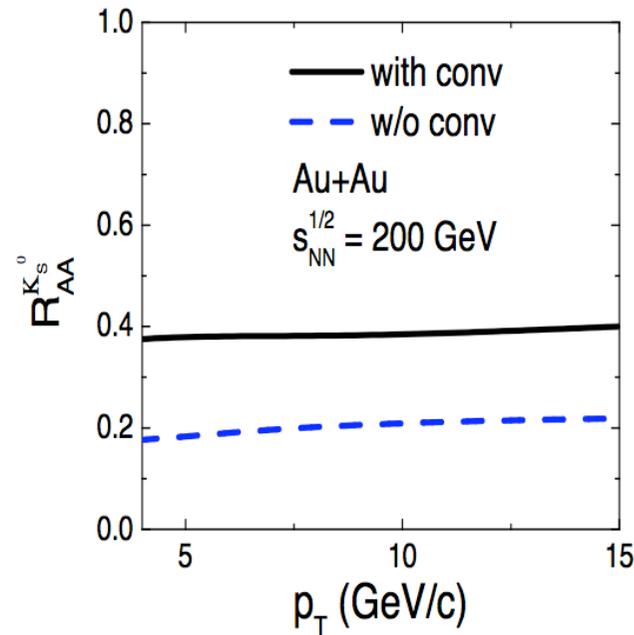
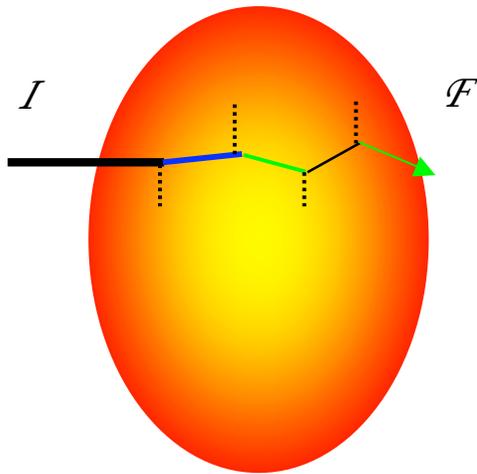
- $R_{AA} \ll 1$ and disappearance of back-back pairs...
 - **Two major experimental observations from RHIC**
- Energy distribution in A+A jets clearly altered relative to p+p...
 - Jets are **quenched** at high p_T
- How might quenching affect the A+A jet chemistry relative to p+p?
 - **Two ideas...**



Motivation

Parton flavor changing...

Fries and Liu, Phys. Rev. C77 (2008) 054902, see next talk by R Fries...

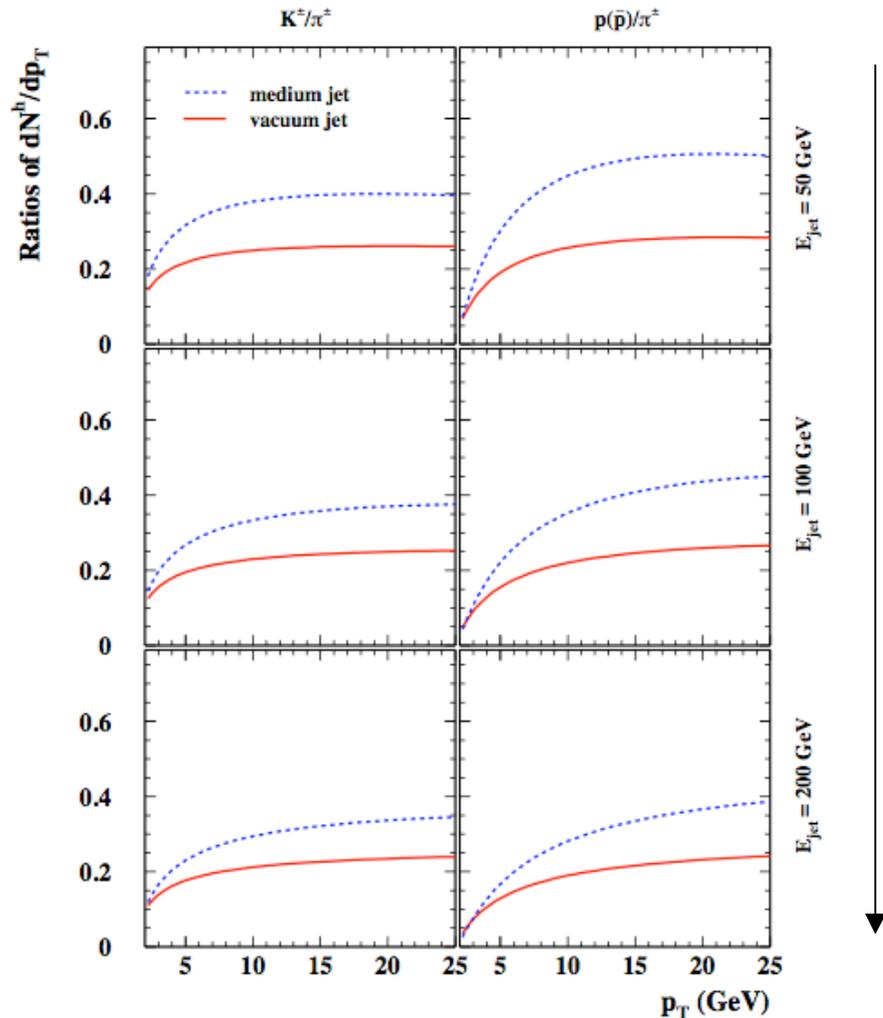


- Hard scatter partons interact with A+A medium, some change flavor
- **Abundance of s quarks in QGP boosts Kaon R_{AA} ~ factor of 2**
- **Proton/pion R_{AA} ~ 1**



Motivation

Medium modification of parton shower...



Sepatta and Wiedemann, Eur.Phys.J.C55:293-302,2008

- Parton cascade from hard scatter altered in medium...

- Increase probability of parton splitting in MLLA formalism...

- Mechanism may lead to higher p/π and K/π ratios in A+A jets..

- In medium fragmentation functions softened...



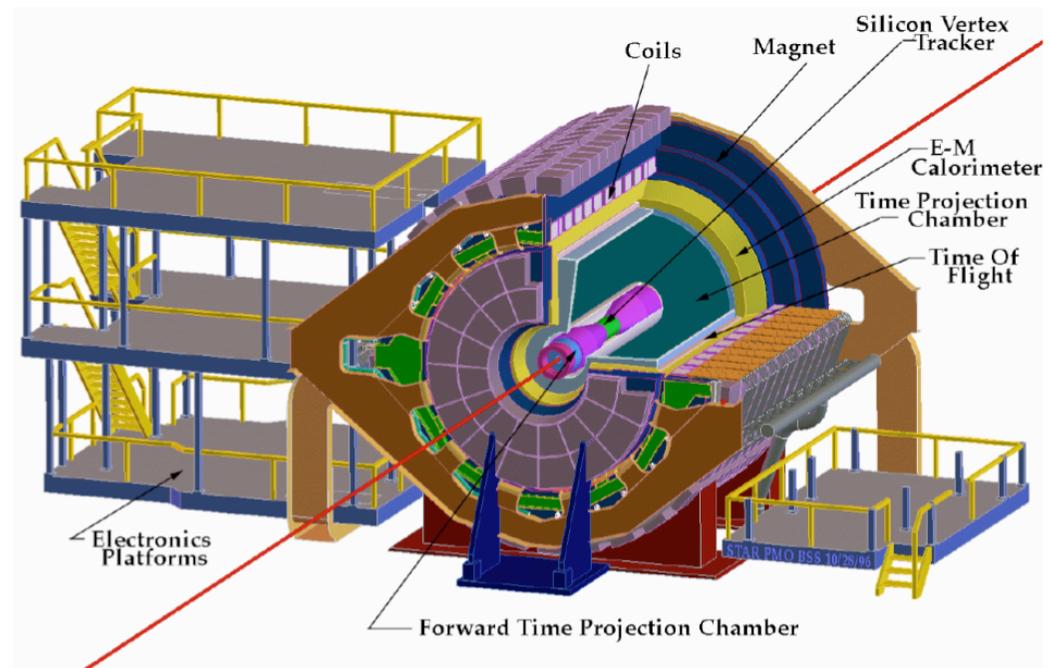
The STAR Experiment

□ p+p 200 GeV...

- Data taken 2006
- EM Calorimeter triggered
- Extend previously published spectra to higher p_T

□ Au+Au 200 GeV...

- Taken 2004
- Mixture of minimum bias and centrally triggered data
- Again, pushes previous spectra out further...



Both p+p and Au+Au analyses use TPC only tracking....



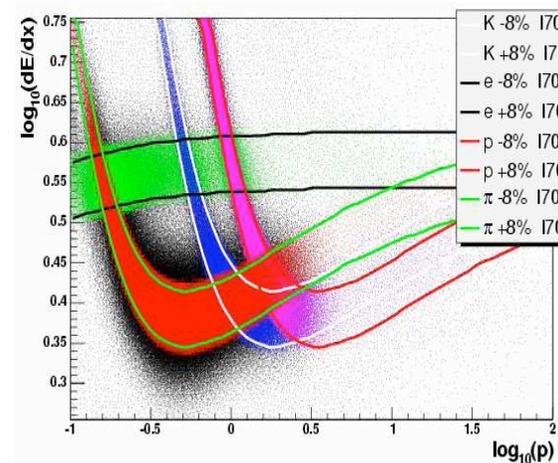
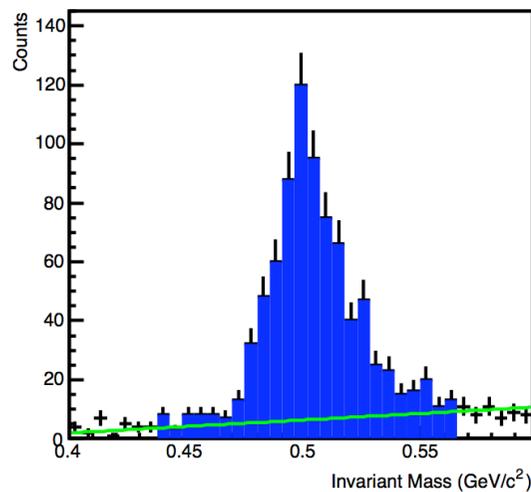
The STAR Experiment

PID...

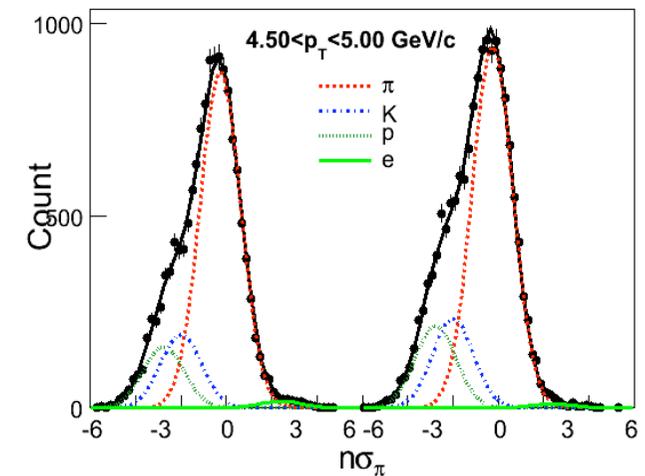
$5.5 < p_T < 6 \text{ GeV}/c$

STAR Preliminary

arXiv:nucl-ex/0505026v2



STAR Preliminary



- STAR has excellent PID at high- p_T

...

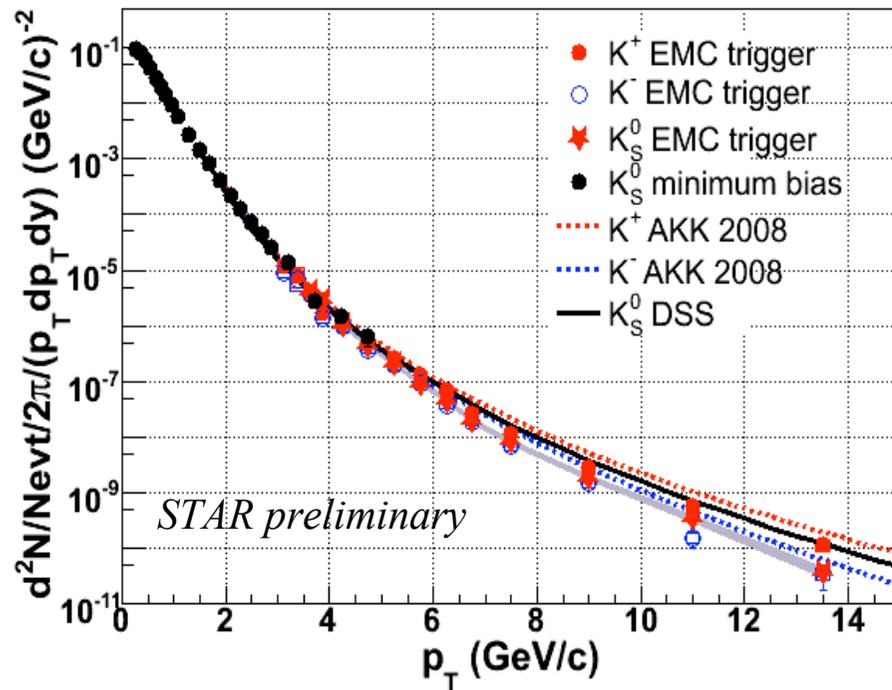
- **Invariant mass method used to identify K_S^0**
 - Mass resolution $\sim 5\%$
- **Relativistic rise dE/dx used to identify charged π , K, p**
 - dE/dx resolution $\sim 8\%$



Results

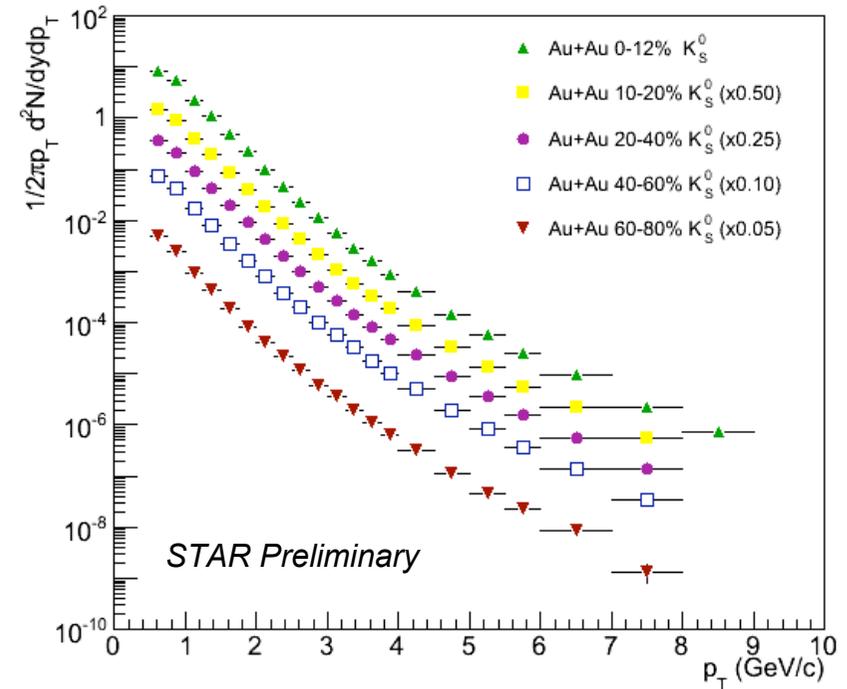
Kaon spectra...

p+p 200 GeV



Y Xu, Quark Matter 2009

Au+Au 200 GeV



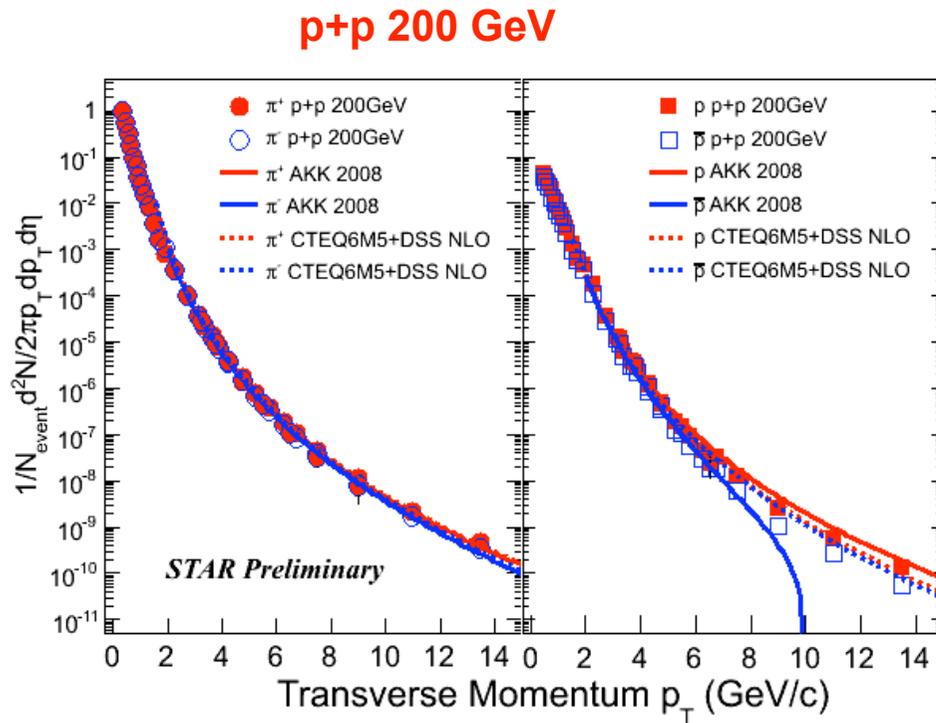
A Timmins, Quark Matter 2009

- p+p 200 GeV kaon spectra reaches out to ~13 GeV/c
- Au+Au 200 GeV reaches out to ~8-9 GeV/c

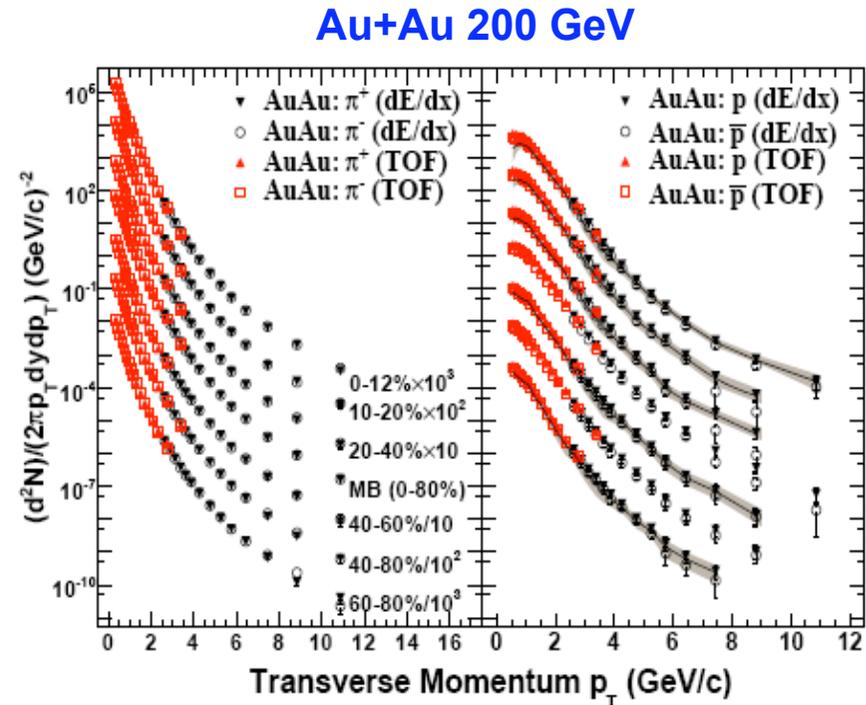


Results

Pion spectra...



Y Xu, Quark Matter 2009



Phys. Rev. Lett. 97 (2006) 152301

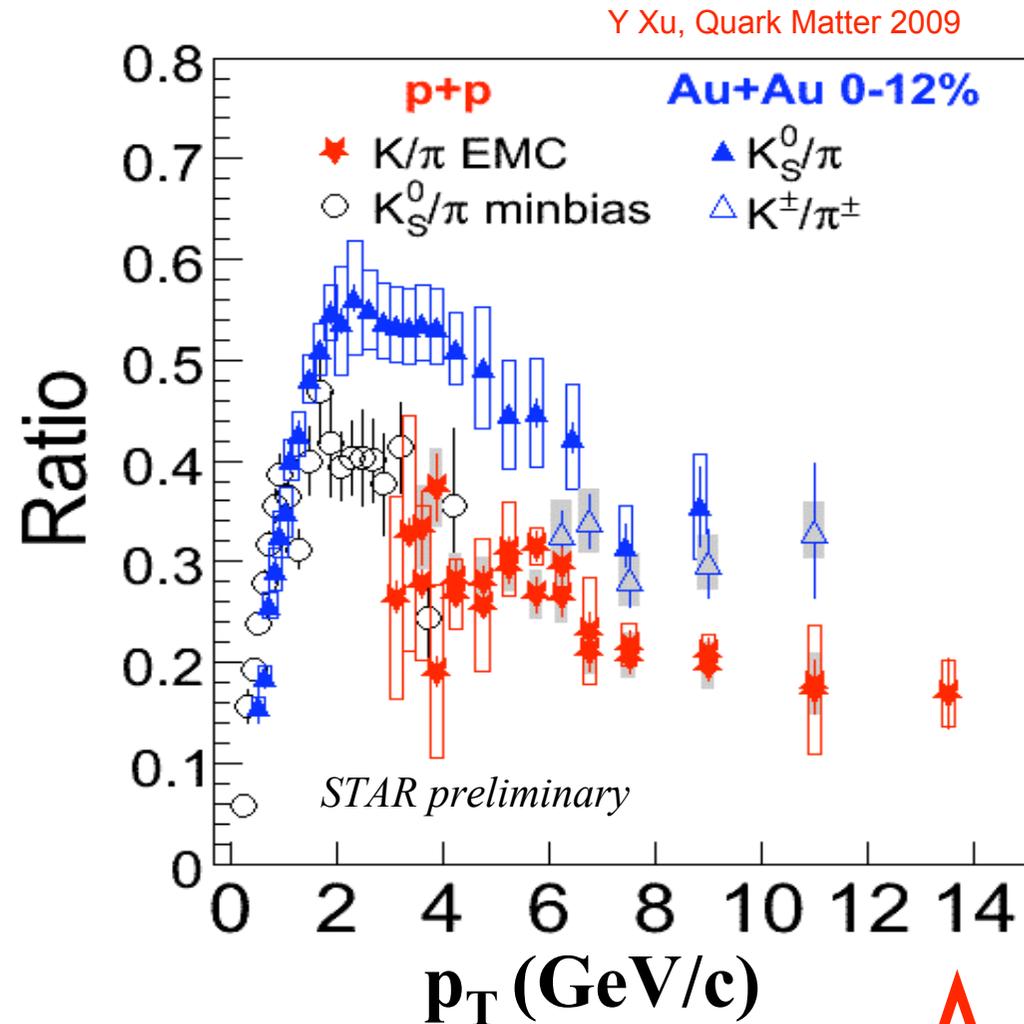
- p+p 200 GeV pion/proton spectra reaches out to ~ 13 GeV/c
- Au+Au 200 GeV reaches out to ~ 10 GeV/c



Results

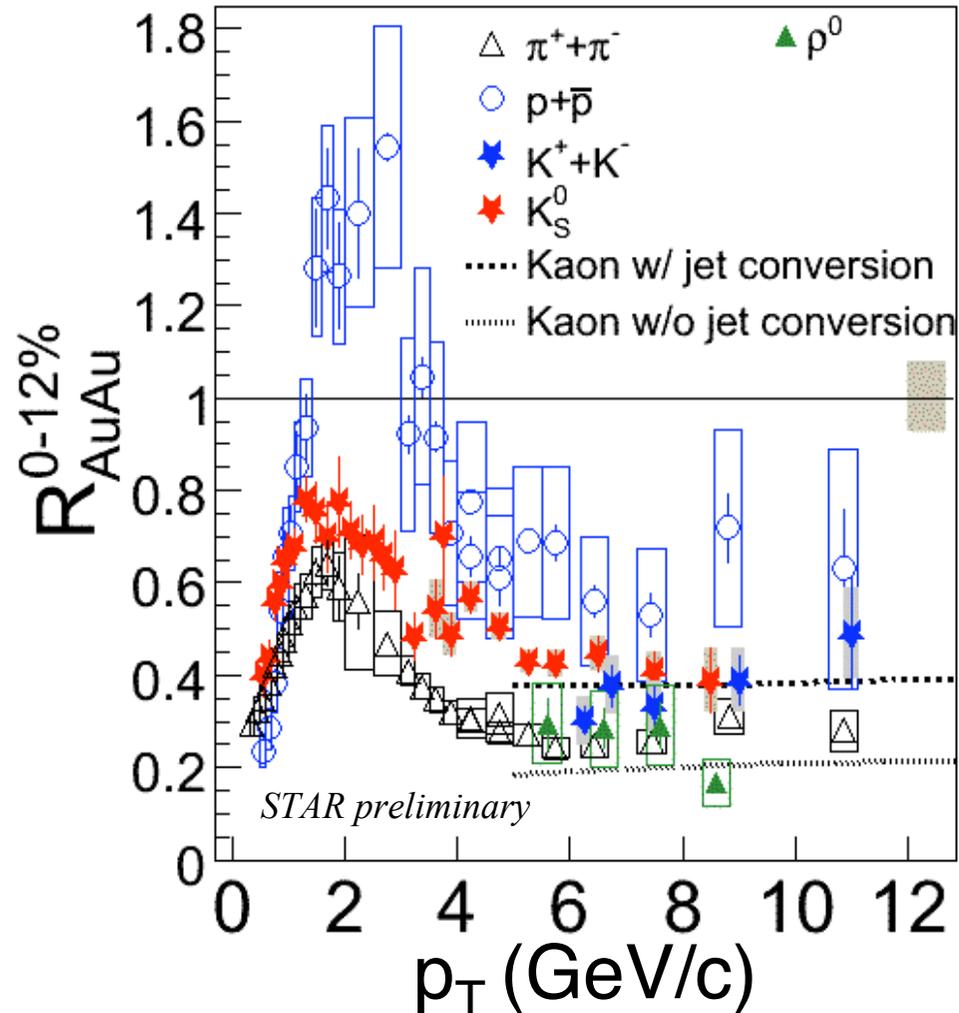
K/π ratio at high- p_T ...

- p+p minbias and EMC triggered ratios consistent
- K/π (central Au+Au) > K/π (p+p) at high- p_T
- Differences applies for highest p_T bins...
 - ~9-11 GeV/c
- Jet chemistry in heavy-ion collisions appears **altered**...



Results

R_{AA} for identified particles...



Y Xu, A Timmins, Quark Matter 2009

□ $R_{AA}(K) > R_{AA}(\pi)$

□ Expected since...

$$- \frac{R_{AA}(K)}{R_{AA}(\pi)} = \frac{K/\pi(Au + Au)}{K/\pi(p + p)}$$

– **Consistent** with current flavor conversion predictions..

□ $R_{AA}(p) > R_{AA}(\pi)$...

– **Inconsistent** with flavor changing predictions

– Expected for splitting modification?

□ p/π ratio higher in Au+Au

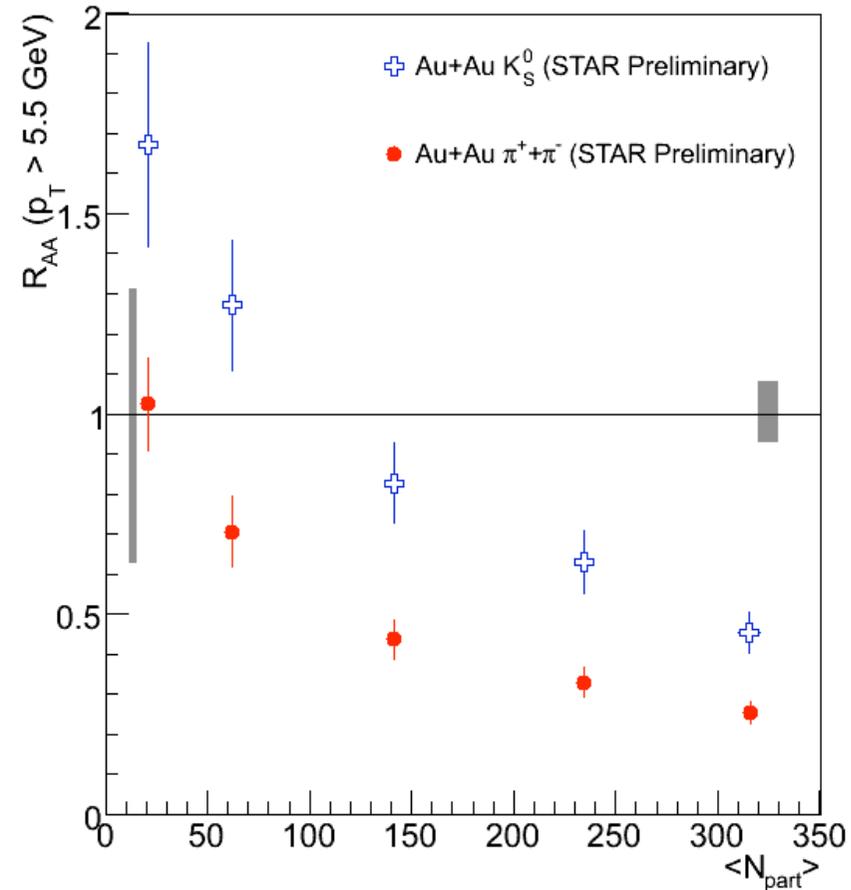
□ $R_{AA}(p) \sim R_{AA}(\pi)$



Results

R_{AA} as a function of system size...

- Measure integrated R_{AA} for $p_T > 5.5$ GeV/c...
 - $\langle p_T \rangle \sim 6.2$ GeV/c
- K/π (all centralities Au+Au) $>$ K/π (p+p)
- Higher ratio for Au+Au where $\langle N_{part} \rangle \sim 20$
 - Jet chemistry changes in small systems?
 - Do we have to push higher in p_T for changes in jet chemistry?
- STAR plans on taking more Au+Au data...



A Timmins, Quark Matter 2009



Summary

- **K/ π ratio at $p_T > 9$ GeV/c higher in central Au+Au compared to p+p at 200 GeV**
 - Jet chemistry appears altered in Au+Au jets...

- **$R_{AA}(K)$ and $R_{AA}(p) > R_{AA}(\pi)$ for central Au+Au**
 - Not a mass effect $R_{AA}(\pi) \sim R_{AA}(\rho)$
 - Higher $R_{AA}(K)$ **consistent** with current flavor conversion predictions
 - Higher $R_{AA}(p)$ **inconsistent** with flavor conversion predictions
 - Can modified parton splitting also contribute?

- **$R_{AA}(K) > R_{AA}(\pi)$ for peripheral Au+Au at $p_T \sim 6.2$ GeV/c**
 - Does jet chemistry change in small systems?

